PCT/GB 2003/004676

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ



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Signed M Cooke

Dated 17 December 2003

Patents Form 1/77

# The Patent Office

310CT02 E759821-6 D02136
P01/7700 0.00-0225290.6

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## Request for grant of a patent

*(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)*

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference RJ/MH/N13204

2. Patent application number *(The Patent Office will fill this part)* 0225290.6 — 30 OCT 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

**The Secretary of State for Trade & Industry**
1 Victoria Street
London
SW1 0ET

Patents ADP number *(if you know it)* 7649098001

If the applicant is a corporate body, give the country/state of its incorporation: United Kingdom

4. Title of the invention
**Anti-counterfeiting apparatus and method**

5. Name of your agent *(if you have one)* WILLIAMS POWELL

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*
4 St. Paul's Churchyard
London
EC4M 8AY

Patents ADP number *(if you know it)* 5830310001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

| Country | Priority application number *(if you know it)* | Date of filing *(day / month / year)* |
|---|---|---|

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application.

| Number of earlier application | Date of filing *(day / month / year)* |
|---|---|

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(answer 'Yes if:*
*a) any applicant named in part 3 is not an inventor, or*
*b) there is an inventor who is not named as an applicant, or*
*c) any named applicant is a corporate body.*
*See note (d))*

Yes

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

| | |
|---|---|
| Continuation sheets of this form | |
| Description | 3 |
| Claim(*s*) | |
| Abstract | |
| Drawing(*s*) | |

10. If you are filing one of the following, state how many against each item.

| | |
|---|---|
| Priority documents | |
| Translations of priority documents | |
| Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* | |
| Request for preliminary examination and search *(Patents Form 9/77)* | |
| Request for substantive examination *(Patents Form 10/77)* | |
| Any other documents *(please specify)* | |

11. I/we request the grant of a patent on the basis of this application.

Signature

Date
30 October 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr Lee Anderson 020 7329 4400

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**Notes**

*a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

*b) Write your answers in capital letters using black ink or you may type them.*

*c) If there is not enough space for all the relevant details on any part of this form, please continue on a sepate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

*d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

*e) Once you have filled in the form you must remember to sign and date it.*

*f) For details of the fee and ways to pay please contact the Patent Office.*

# ANTI-COUNTERFEITING APPARATUS AND METHOD

The present invention relates to apparatus and a method for providing anti-counterfeiting features to security articles, such as security paper, banknotes and the like.

Many forms of security devices have been produced over the years to seek to reduce the incidence of counterfeiting. However, most of these devices tend to become liable to replication over time by counterfeiters.

The present invention seeks to provide an improved security device and method for articles, including banknotes and other security paper. The device and method are not limited in application to paper products, as will be apparent to the skilled person.

According to an aspect of the present invention, there is provided a security device for an article including a coded item having coding units of the order of nanometres in at least two dimensions.

The coded item may be a barcode and the coding units the individual bars of the code.

Advantageously, the coding units provide a three-dimensional code.

According to another aspect of the present invention, there is provided a security device for an article including a coded item providing a three-dimensional security code.

Preferably, the security device is designed for provision on or in a currency banknote or other security paper.

The preferred embodiment provides a 3D nanometre scale data encryption key. It consists in using 3D polymer patterns on silicon substrates as evolved, tri-dimensional bar codes. It provides several possible degrees of encryption which, together with the high technology involved, makes it virtually impossible to counterfeit. There is described the basic geometry, the process, the coding principles through such structures, and the reading

principles.

The preferred geometry is that of an array of lines, similar to a bar code when seen from above, with the difference that lines have dimensions in the tens of nanometre range. These lines are preferably made of a cross-linked, modified polymethyl methacrylate. Cross-linking by ultra-violet light gives them an exceptional mechanical durability for structures of this size.

The structure is preferably processed from a polymer film spun on a silicon substrate of about 20 μm of thickness. In that dimension range, silicon is as flexible as paper and yet, retains all its physical properties. The polymer layer is imprinted by a mask having characteristic details in the tens of nanometre range, a chemical route is then used to dissolve partly the polymer so that lines of various dimensions are left on the substrate. These are further cross-linked by ultra-violet light.

The other side of the silicon wafer is chemically treated by a silane, whose function is to provide enhanced adhesion to the destined object, a banknote for the example. A large number of quasi identical structures is produced on the wafer, they are further severed by a cutting step. This step is preferably realised by water jet guided laser cutting. The resulting silicon + polymer marker artefact has typical dimensions of 50 x 5 x 20 $\mu m^3$, typically in the range of well-cut beard hair.

The location and reading of the key basically proceeds in two steps. First, the micrometre artefact is located on the banknote, by using a laser in the infra-red range (silicon being a semi-conductor absorbs in the red). A simple charge-coupled device is used to detect the reflection of the silicon and gross co-ordinates are obtained. Second, these co-ordinates are used to position an atomic force microscopy-type device, which will read the 3D information carried by the polymer lines. The polymer lines have a pyramid slanted pyramid shape, and bear a single or double encryption. Single encryption corresponds to a barcode, and lines of alternated width define a code of up to 128-bits. This code cannot be broken by modern computers in a reasonable time, and is changed.

according to the life of the stamp, that is approximately once every ten to hundred thousand with current NIL.

Double encryption uses the third dimension to generate a second encryption key, that is in effect a code up to $128^2$-bits: unbreakable, even by a quantum computer. The pyramid shape allows location of the beginning of the key.

The AFM tip is positioned at the upper right corner of the 3D bar code. It then makes two readings, the first one from left to right of the bar width at 1/3 from the top of the structure, and on the way back (from right to left), the height is recorded at a position of 2/3 of the structure. This allows the structure formed by the polymer lines to bear a double 128-bit encryption key, defined by the width and the height of the structure.